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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Jay E. Uglow

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EXAMINER

KIELIN, ERIK J

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 01/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

4

<b>Office Action Summary</b>	Application No.	Applicant(s)	
	09/785,999	UGLOW ET AL.	
	Examiner	Art Unit	
	Erik Kielin	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 November 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-9 and 33-35 is/are pending in the application.
- 4a) Of the above claim(s) none is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 33-35 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |                                                                                                    |                                                                             |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                                   | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)               | Paper No(s)/Mail Date. _____                                                |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>7/19/2004</u> .                                                           | 6) <input type="checkbox"/> Other: _____                                    |

**DETAILED ACTION*****Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/22/2004 has been entered.

***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 2, 3, 5-9 and 33-35 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation of forming the inter-metal dielectric structure performing the steps "consisting of" (d)(i) and (d)(ii). The dependent claims 2, 3, 5-9 and 33-35 add additional features to the steps (d)(i) and (d)(ii), sometimes using open-ended language of "comprising," which is improper given the "consisting of" language because it would return the claim to open-ended again. In this regard, MPEP 2111.03 [R-2] states,

**"The transitional phrase "consisting of" excludes any element, step, or ingredient not specified in the claim. *In re Gray*, 53 F.2d 520, 11 USPQ 255 (CCPA 1931); *Ex parte Davis*, 80 USPQ 448, 450 (Bd. App. 1948) ("consisting of" defined as "closing the claim to the inclusion of materials other than those recited except**

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for impurities ordinarily associated therewith." ). >But see *Norian Corp. v. Stryker Corp.*, 363 F.3d 1321, 1331-32, 70 USPQ2d 1508, 1516 (Fed. Cir. 2004) (holding that a bone repair kit "consisting of" claimed chemicals was infringed by a bone repair kit including a spatula in addition to the claimed chemicals because the presence of the spatula was unrelated to the claimed invention). < **A claim which depends from a claim which "consists of" the recited elements or steps cannot add an element or step.** When the phrase "consists of" appears in a clause of the body of a claim, rather than immediately following the preamble, **it limits only the element set forth in that clause; other elements are not excluded from the claim as a whole.** *Mannesmann Demag Corp. v. Engineered Metal Products Co.*, 793 F.2d 1279, 230 USPQ 45 (Fed. Cir. 1986)." (Emphasis added.)

Accordingly, the dependent claims are indefinite for further defining or adding features to the clause of claim 1 directed to the steps of forming the inter-metal dielectric structure.

For the purposes of patentability of the dependent claims 2, 3, 5-9 and 33-35, "consisting of" in claim 1 will be taken to mean "comprising" because that is the context in which the dependent claims use the claim 1. Otherwise, each of the dependent claims cannot be examined.

### ***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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5. Claims 1-4 and 35 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6,197,696 B1 (**Aoi**).

Regarding claims 1, 4 and 33, **Aoi** discloses a method for making a dielectric structure for dual damascene applications, the method comprising:

(a) providing a substrate **350** (Fig. 15(a) );

(b) fabricating a first metallization metallization lines **351** in the substrate **350** (Fig. 15(a) );

(c) forming a barrier layer **352** of silicon nitride (col. 19, lines 1-2) --as further limited by instant claim 4-- over the first metallization lines **351** and the substrate **350** (Fig. 15(a));

(d) forming an inter-metal dielectric structure, the forming of the inter-metal dielectric structure consisting of:

(d)(i) forming an inorganic dielectric layer **353** of silicon dioxide (col. 19, lines 3-5) to define a via dielectric layer **353A** directly over the barrier layer **352**, the inorganic dielectric layer **353** having a dielectric constant of about 4 (col. 1, lines 53-54) --as further limited by instant claim 35-- and being highly selective relative to the barrier layer **352** when etched (as shown in Fig. 16(c) ); and

(d)(ii) forming a carbon doped oxide layer **354** (called "organic layer" at col. 19, lines 6-8) to define a trench dielectric layer **354A** that is defined directly over and in direct contact with the inorganic dielectric layer **353**, the trench layer **354** being formed to define a metallization line layer **365** (Fig. 16(d) and 17(c) ).

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**Note** that **Aoi** defines “organic layer” to include carbon-doped oxides (called “organic-containing silicon dioxide”) such as formed by CVD from precursors such as hexamethyldisiloxane, arylalkoxy silane, etcetera at col. 10, lines 54-62.

(See section entitled, “Modified Example of Embodiment 3” beginning in col. 18, line 60 for details of the embodiment used above from **Aoi** to reject the claim 1.)

Regarding claim 2, **Aoi** further discloses forming a trench **362** in the carbon doped oxide layer using a first etch chemistry (Fig. 16(d); col. 19, lines 50-62).

Regarding claim 3, **Aoi** discloses a method for making a dielectric structure for dual-damascene applications as recited in claim 2, further comprising:

forming a via **361** in the inorganic dielectric layer **353** using a second etch chemistry, the second etch chemistry being different than the first etch chemistry and the via **361** being within the trench **362** (col. 19, lines 41-62).

### *Claim Rejections - 35 USC § 103*

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Aoi** in view of US 6,110,648 (**Jang**).

**Aoi** teaches **exemplary** thicknesses of the via **353A** and trench **354A** dielectric layers of 1  $\mu\text{m}$  and 0.4  $\mu\text{m}$ , respectively (**Aoi**, col. 19, lines 4-8). **Aoi** does not teach via

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dielectric layer thicknesses of 0.4 to 0.5  $\mu\text{m}$  and trench dielectric layer thicknesses of 0.5 to 0.6  $\mu\text{m}$ .

**Jang** --like **Aoi**-- teaches a dual damascene process wherein the via **120a** and trench **120b** dielectric layers are made of different dielectric layers including an oxide and a low-k dielectric. Accordingly **Jang** and **Aoi** are drawn to the same field of endeavor. The thickness of the via dielectric layer **120a** is 0.5  $\mu\text{m}$  to 0.8  $\mu\text{m}$  (5000 Å to 8000 Å), and the thickness of the trench dielectric layer **120b** is 0.5  $\mu\text{m}$  to 0.8  $\mu\text{m}$  (5000 Å to 9000 Å), which overlap the claimed ranges. Moreover, it is noted that the instant specification indicates that the thicknesses are exemplary. Accordingly, there exists no evidence of record indicating that the thicknesses are critical. **Aoi** also indicates that the thicknesses are exemplary.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use the dielectric layer thicknesses of **Jang** as the thicknesses in **Aoi** in order to use less of the high-k, via dielectric layer **353A** (1  $\mu\text{m}$  in the example in **Aoi** but 0.5  $\mu\text{m}$  to 0.8  $\mu\text{m}$  in **Jang**), thereby reducing the overall dielectric constant of the ILD which reduces the RC delay and increases signal speed. A faster semiconductor device results.

Further in this regard, it has been held that

“Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art... such ranges are termed ‘critical ranges’ and the applicant has the burden of proving such criticality ... **More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable**

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**ranges by routine experimentation.”** *In re Aller* 105 USPQ233, 255 (CCPA 1955). (Emphasis added.)

See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sold* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

8. Claims 5 and 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Aoi** in view of the basic text of **Wolf**, et al. Silicon Processing for the VLSI Era, Vol. 2-Process Integration, Lattice Press: Sunset Beach CA, 1990, p. 194.

Regarding claims 5, 7, and 8, the prior art of **Aoi**, as explained above, discloses each of the claimed features except for indicating that the silicon dioxide layer **353** is made from TEOS. **Aoi** does however state,

“The first and second silicon dioxide films **353** and **355** may be deposited by **any arbitrary technique**. For example, these films **353** and **355** may be deposited by a **CVD process** using a reactive gas mainly composed of phenyltrimethoxy silane.” (Emphasis added. **Aoi**, col. 19, lines 13-17.)

**Wolf** teaches that it is notoriously well-known in the art to form silicon dioxide using CVD from TEOS for forming dielectric films for multi-level interconnect metallization (p. 194), such as in the multilevel interconnect metallization of **Aoi**.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use TEOS to form the silicon dioxide layer **353** of **Aoi**, because **Aoi** teaches that any arbitrary method and particularly CVD can be used and **Wolf** teaches TEOS is known for making silicon dioxide for multi-level metallization.



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Further regarding claim 8, **Aoi** discloses a method for making a dielectric structure for dual-damascene applications as recited in claim 7, wherein the first etch chemistry is optimized to etch through the carbon doped oxide layer and the second etch chemistry is optimized to etch through the silicon dioxide layer.

Regarding claim 9, **Aoi** discloses a method for making a dielectric structure for dual-damascene applications as recited in claim 8, wherein, the second etch chemistry is selective to the barrier layer **352** as shown in Fig. 16(d) and 17(a); col. 20, lines 3-13).

9. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Aoi** in view of **Jang**, as applied to claims 1-4, and 33 above and further in view of US 6,043,167 (**Lee et al.**).

The prior art of **Aoi**, as explained above, discloses each of the claimed features except for indicating the low-dielectric constant, carbon-doped oxide layer has a dielectric constant layer of about and no greater than 3.0.

**Lee** teaches a method of forming a carbon-doped silicon oxide film for use as intermetal dielectrics which can have a dielectric constant of no more than 3.0, as shown in Fig. 2 (col. 1, lines 8-12).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use the carbon-doped silicon oxide film having a dielectric constant of no more than 3.0 of **Lee** as the carbon-doped silicon oxide film of **Aoi**, because **Aoi** suggests using a low-dielectric constant, carbon-doped silicon oxide layer, and **Lee** teaches such a layer for interlayer dielectrics having a low dielectric constant that reduces RC delay ("crosstalk") and additionally confers the benefits of low internal stress (paragraph

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bridging cols. 2-3). Moreover, it is a goal of the semiconductor industry to minimize RC delay and thereby speed up chip speeds, such that one of ordinary skill is always motivated to reduce the dielectric constant as far as possible.

### ***Response to Arguments***

10. Applicant's arguments filed 22 November 2004 have been fully considered but they are not persuasive.

Applicant argues that Aoi in view of Jang does not disclose the instantly claimed invention. Given the amendments to the claims, Aoi alone anticipates claims 1-4 and 33 for reasons set forth above in the rejection.

Jang was applied to show at least well known thicknesses for via and trench layers for metallization. As amended, Jang is only necessary to reject claims 33 and 34.


### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 571-272-1693. The examiner can normally be reached from 9:00 - 19:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Erik Kielin  
Primary Examiner  
January 24, 2005